

<b>CH2M HILL Hanford Group, Inc.</b>	<b>Manual</b>	<b>ESHQ</b>
<b>HEAT STRESS CONTROL</b>	<b>Document</b>	<b>TFC-ESHQ-S_IH-C-07, REV B-2</b>
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## **1.0 PURPOSE AND SCOPE**

(7.1.1, 7.1.2)

This procedure provides requirements to identify, evaluate, and control worker heat stress in both indoor and outdoor work environments.

This procedure applies to all CH2M HILL activities where heat stress conditions may be involved.

Certain medical services are outside the scope of this document, including:

- Medical intervention for treatment of heat stress illness by the first aid stations or the medical providers
- Fitness-for-duty protocol or medical certification to perform work in hot environments.

## **2.0 IMPLEMENTATION**

This procedure is effective on the date shown in the header.

## **3.0 RESPONSIBILITIES**

### **3.1 ESHQ Vice President**

Assign a heat stress mitigation program manager to coordinate Safety and Operation's implementation of heat stress mitigation activities.

### **3.2 Heat Stress Mitigation Program Manager**

- Facilitates the annual kick off of summarization activities by March 1. This includes:
  - Coordination with Facility Maintenance directors to ensure that required electrical and mechanical preventative maintenance is performed.
  - Coordination with Operations and Project directors to ensure that sufficient long lead heat stress mitigation equipment is available to support the summer work schedule.
  - Coordination with the Directors of Communications and Safety and Health to develop and print a Focus article for heat stress mitigation during the month of May.
  - Coordination with the Director of Safety and Health to develop tail gate slides for company wide presentation each week during the month of June or sooner if summer temperatures dictate earlier presentations.

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- Provide support during the summer months for Operations, Projects, and Safety to ensure heat stress mitigation activities are properly mitigated.
- At the end of the high heat season, coordinate with Operations and Project directors to ensure heat stress mitigation equipment is properly stored for future use.

### 3.3 Facility Maintenance Director

Ensure that required electrical and mechanical preventative maintenance for all heat stress mitigation equipment assigned to the facility is performed prior to onset of summer heat (April 1).

### 3.4 Industrial Hygienist

- Participate in job hazard and work site hazard analysis as requested to determine the potential for heat stress. Using Attachment A, assist in the determination of equipment, Personnel Protective Equipment (PPE), or techniques that should be used to mitigate the heat stress potential.
- Participate in pre-job briefings or other processes communicating the hazards associated with heat stress conditions at the work site and the control methods to be used.
- Assist line management in applying heat stress exposure guidelines using Attachment B to establish work/rest regimens.
- Identify other factors that may alter the interpretation and use of Attachment B and determine exposure limits accordingly.
- Investigate heat stress disorder cases.

### 3.5 Employees

- Participate in heat stress prevention activities, e.g., job planning, work site hazard analysis, and pre-job briefings.
- Be aware of means to avoid heat stress.
- Select and wear personal clothing, as appropriate, to minimize body heat build-up (whether worn alone or in combination with work uniform).
- Wear appropriate PPE as required on the Worksite Hazard Analysis (WHA), Safety Plan, work package, or Radiological Work Permits (RWPs) to minimize body heat build-up.
- Understand lifestyle factors that increase the risk of heat injury or illness.
- Recognize the signs and symptoms of heat stress.
- If signs and symptoms of heat stress develop, inform supervisors and take appropriate action, such as immediately exiting the work area.

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#### 4.0 PROCEDURE

See Figure 1.

#### 4.1 Preparation for Potential Heat Stress Conditions (Medical Evaluation & Training)

- |              |   |
|--------------|---|
| Line Manager | <ol style="list-style-type: none"> <li>1. Ensure that personnel assigned to work in heat stress conditions have been identified for this work activity through the employee job task analysis process (<a href="#">TFC-ESHQ-S_IH-C-17</a>).</li> <li>2. Ensure that employees who are working in or supervising work in hot environments have been briefed in heat stress recognition, prevention, and control (see Attachment C, Heat Stress Briefing Content).</li> </ol> |
|--------------|---|

#### 4.2 Identification of Potential Heat Stress Conditions/Plan Controls

- |              |  |
|--------------|--|
| Line Manager | <ol style="list-style-type: none"> <li>1. If, during the work planning process (<a href="#">TFC-ESHQ-S-SAF-C-02</a>, <a href="#">TFC-OPS-MAINT-C-01</a> or <a href="#">TFC-OPS-OPER-C-13</a>), a potential for heat stress is identified (see Attachment Ca, Heat Stress Risk Factors), obtain support from the Industrial Hygienist to evaluate hazards and recommend controls.               <ol style="list-style-type: none"> <li>a. Plan to conduct heat stress monitoring if the WBGT indicates the beginning of work/rest cycles and impermeable clothing will be worn.</li> <li>b. Industrial Hygiene and Field Work Supervisor should consider heat stress monitoring whenever work/rest cycles are required.</li> </ol> </li> <li>2. As part of the above step, specify heat stress controls in the WHA, Safety Plan, work package, or RWP (see Attachment A, Heat Stress Mitigation Check List).</li> </ol> |
|--------------|--|

NOTE: For the use of air conditioned controls in a controlled area or radiologically controlled area, see [TFC-ESHQ-RP\\_ADM-CD-21](#).

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- |                      |  |
|----------------------|--|
| Industrial Hygienist | <p>3. As part of work planning above, provide guidance and recommendations of the following:</p> <ul style="list-style-type: none"> <li>• Workload category (see Attachment D, Estimating Work Load Activity Level).</li> <li>• Acclimatization status (see Attachment D, Heat Stress Acclimatization).</li> <li>• Use of clothing that severely restricts heat removal, such as water-vapor-impermeable, air-impermeable, and thermally-insulating clothing; encapsulating suits; or multiple layered clothing, e.g., clothing types not specified in Attachment B, Table B-1.</li> <li>• Use of personal protective equipment to prevent heat stress, e.g., vortex coolers, ice vests, cool vests, breathable anti-contamination suits, and OREX or GORTEX water proof suits instead of impermeable suits when dealing with particulate radioactivity.</li> <li>• Anticipated work shifts of more than eight hours.</li> <li>• Use of personal heat stress monitoring in accordance with Section 4.5 <del>or 4.6</del>, or other heat stress management controls.</li> </ul> |
|----------------------|--|

#### 4.3 Applying Heat Stress Control Strategies - Items Requiring Lead Time

- |                      |   |
|----------------------|---|
| Line Manager         | <p>1. Control strategies identified in Section 4.2, step 2, requiring long lead times for approval and purchase will be implemented in a timely manner so that the control strategy will be available, when needed.</p> <p>NOTE: Special engineering controls, personal protective equipment, and some changes in work schedules are examples of longer lead-time controls.</p> |
| Industrial Hygienist | <p>2. Assist line management, as requested, in the purchase, issue, and use of cooling devices or other protective equipment.</p>   |

#### 4.4 Applying Heat Stress Control Strategies - Daily Work Management

- |                      |   |
|----------------------|---|
| Line Manager         | <p>1. Ensure water/fluids are provided to workers (see Attachment C, Drinking Water/Fluids).</p> <p>NOTE: For providing water in a radiological contamination area, see <a href="#">TFC-ESHQ-RP_MON-C-22</a>.</p> <p>a. Encourage workers to drink fluids before entering the work area and continually throughout the day.</p> |
| Industrial Hygienist | <p>2. Advise management of worker acclimatization status.</p>   |

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- |   |  |
|---|--|
| Line Manager                                      | <p>3. Implement acclimatization status established above for individuals working in potential heat stress environments.</p> <p>4. As appropriate, provide for a rest area that is properly shaded with additional cooling and misting equipment when appropriate.</p> <p>5. Communicate to affected employees in regular pre-job briefings expected temperature readings/environmental data, as well as first aid/emergency procedures for heat stress related illnesses, work uniform expectations, and additional heat stress information as necessary.</p>  |
| Line Manager/<br>Industrial Hygiene<br>Technician | <p>6. Establish work/rest regimens for work groups using wet bulb globe temperature (WBGT) data, classification of the work activity level (work load), and the information in Attachment B (with Industrial Hygiene involvement, as necessary).</p> <p>NOTE: Work activity level and acclimatization requirements are provided by the industrial hygienist. These requirements should be documented on the Worksite Hazards Analysis checklist.</p>   |
| Line Manager                                      | <p>7. If directed by the Industrial Hygienist (or by work planning controls), ensure that work site WBGT readings are taken at the job site (see Attachment D for WBGT Monitoring - Work Site Specific).</p> <p>NOTE: Where work site WBGT monitoring is unspecified, general area WBGT data from the PNNL weather station may be used.</p> <p>8. Contact the Industrial Hygienist for guidance if:</p> <ul style="list-style-type: none"> <li>• Work/rest regimen meets or exceeds 50% rest, or</li> <li>• Work shift will exceed eight hours.</li> </ul> <p>9. When work site WBGT readings are obtained, ensure that the direct reading instrument number is obtained from the Industrial Hygiene Technician and documented in the work package.</p> <p>NOTE: It is NOT necessary to log WBGT readings obtained from the PNNL weather station.</p> <p>10. Communicate to the effected personnel during the pre-job briefings the planned use of heat stress mitigation techniques and then ensure that the additional heat stress monitoring or control strategy specified in the work planning process is implemented (personal monitoring, personal protective equipment controls for heat stress, etc.).</p> |
| Industrial Hygienist                              | <p>11. When personal heat stress monitoring is required, collect, interpret, and document work site specific personal heat stress and environmental monitoring data.</p>   |

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## 4.5 Conducting and Documenting Work Place Heat Stress

### 4.5.1 Pre-Survey Personal Monitoring

- |                               |  |
|-------------------------------|--|
| Industrial Hygiene Technician | <ol style="list-style-type: none"> <li>1. Prior to starting work, establish the means for notification of the Field Work Supervisor (FWS) and Project Industrial Hygienist for reporting when a resting heart rate below 110 cannot be attained by a worker after two rest periods, or any worker exhibits symptoms of heat stress.</li> <li>2. Before work begins, record the pre-work, resting heart rate for each employee (see Attachment E).               <ol style="list-style-type: none"> <li>a. Calculate and record each worker's target heart rate. The worker's permissible pulse rate or target rate is calculated as follows:<br/><br/>Target rate equals 180 minus the person's age.<br/><br/>Example: for a 44 year old person, their target heart rate would be 136 beats per minute (<math>180 - 44 = 136</math>).</li> </ol> </li> <li>3. If the worker's pre-work resting heart rate is less than 5 bpm from their target heart rate, inform the FWS that the worker cannot work in a heat stress environment. (Re-measurement of the resting heart rate can be made if there is some question about the representativeness of the initial measurement.)</li> </ol> |
|-------------------------------|--|

### 4.5.2 Pre-Survey Environmental Monitoring

- |                               |  |
|-------------------------------|--|
| Industrial Hygiene Technician | <ol style="list-style-type: none"> <li>1. Determine where to locate the WBGT monitor to best represent the temperature exposure to the work crew.</li> </ol> |
|-------------------------------|--|

### 4.5.3 Survey

- |   |   |
|---|---|
| Industrial Hygiene Technician or Industrial Hygienist | <ol style="list-style-type: none"> <li>1. Conduct and document work place heat stress related environmental and/or personal measurements (i.e., WBGT index or heart (pulse) rate monitoring) as required above (<a href="#">TFC-ESHQ-S_IH-D-26</a> and <a href="#">TFC-ESHQ-S_IH-C-46</a> <del>TFC-ESHQ-IH-STD-03</del>). Document on forms <a href="#">A-6001-760</a>, <a href="#">A-6002-151</a>, or equivalent.</li> </ol> |
| Line Manager  | <ol style="list-style-type: none"> <li>2. When the pre-job briefing indicates predicted extreme heat stress conditions periodically contact the Industrial Hygienist for current work/rest cycles.</li> </ol>   |

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Industrial Hygiene  
Technician

3. Take periodic heart rate measurements at the interval determined by the Industrial Hygienist, record data as indicated above, and make appropriate notifications as directed by the Industrial Hygienist.

NOTE: The target rate is not a peak heart rate limit. It can be exceeded momentarily without adverse health effects in a population with medically assessed normal cardiac performance. However, it is the goal of the survey measurement process to prevent a sustained heart rate in workers which exceeds the target rate, and to identify workers who cannot sufficiently recover their heart rate after rest.

- a. Conduct survey measurements in accordance with the following:

- The requirements in this procedure
- Documentation of the times that the workers are working/resting; the work tasks being performed; the PPE that is actually being worn; heart rate readings taken; and notifications made to the individual workers, FWS, and Project Industrial Hygienist
- If monitoring determines that an individual(s) has reached or exceeded their target heart rate, the individual is required to be informed at that time and should begin a rest period for approximately 15 minutes.

NOTE: Workers can request their heart rate reading at any time during the survey.

Line Manager

- b. Implement rest periods using the workers' target heart rate measurements.

#### 4.5.4 Rest Periods

Industrial Hygiene  
Technician

1. After the 15 minute rest period, check and record the worker's pulse rate.
  - a. If not more than 110 beats per minute, work can begin again.
  - b. If more than 110 beats pre minute, advise the person to rest for another 15 minutes.
  - c. If a person does not recover to below 110 beats per minute (or their pre-work pulse rate) after the second 15 minute rest period, get the person to a cooler environment and notify the FWS and project Industrial Hygienist. Additionally, depending on circumstances, the individual, FWS, and/or industrial hygienists may decide that medical attention is necessary.



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NOTE 1: The rest periods can be conducted in the work area but are most effective if there is shade, ventilation, or cooling to further reduce heat accumulation.

NOTE 2: As long as the person's target heart rate is not exceeded and they take sufficient work breaks to remain hydrated, they can continue working with periodic pulse rate monitoring. Per the Heat Stress program, any person may request a rest/cool off period regardless of their heart rate.

#### 4.5.5 Post-Survey

- |                               |   |
|-------------------------------|---|
| Industrial Hygiene Technician | 1. Complete all required forms and provide them to the Industrial Hygienist by the end of the next working day. |
|-------------------------------|---|

## 5.0 DEFINITIONS

Core body temperature. The temperature of the internal core body. Both ACGIH and National Institute for Occupational Safety and Health (NIOSH) cite a core body temperature of 100.4°F as the limit for daily, prolonged work under heat stress conditions. Measured in the field either by tympanic, skin, or oral temperature readings.

Heat strain. Physiological response to heat stress recognized by: increased core body temperature, increased heart rate or sweating. If these responses are uncontrolled, these symptoms may progress and result in increased incidence of heat stress disorders and accident rates.

Heat stress. The total heat load on the body that results from exposure to external sources and from internal metabolic heat production due to physical work. It occurs when the body produces or gains more heat than it is capable of giving off or losing. Contributing environmental factors affecting the potential for heat stress include air temperature, humidity, radiant heat exchange, and air movement.

Hot environment. A work area where one or more of the following factors may exist, creating the potential for heat stress: high temperature/humidity, sources of significant radiant heat, or use of protective clothing that impedes sweat evaporation.

Heart (Pulse) Rate Monitoring. The monitoring of an individual's heart rate in beats per minute to determine the effect of heat on a person's core body temperature.

Rest. Includes sitting quietly in place or sitting with moderate arm movements in the same environment as the work activity. (See the industrial hygienist for further clarification.)

Threshold limit values (TLV) for heat stress. ACGIH values incorporate work exertion level, personal protective equipment in use, and WBGT temperatures to determine a work/rest regimen that permit nearly all workers to be repeatedly exposed to hot work environments without adverse health effects. Threshold limit values are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and dietary salt intake should be able to function effectively under the given working conditions without exceeding a core body temperature of 100.4°F.

Wet bulb globe temperature. Environmental temperature index used to assess the potential for heat stress. WBGT values may be measured with integrated equipment or calculated using readings from a globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer.

Work/rest regimen. The proportion of time that an individual spends working and resting during an hour duration, and is established based on the WBGT index, work activity level (work loads) exertion level, personal protective equipment worn, and acclimatization status.

## 6.0 RECORDS

The following records are generated during the performance of this ~~procedure-guidance~~ document:

<u>Record Description</u>	<u>Vital Record</u> <u>Y/N</u>	<u>QA Record</u> <u>Y/N</u>	<u>QA Record Retention</u> <u>L/NP</u>	<u>NARA Retention Schedule</u>	<u>Other Retention Requirements</u>	<u>Records Custodian</u>
<u>Industrial Hygiene Direct Reading Instrument Survey form (A-6001-760)</u>	<u>N</u>	<u>Y</u>	<u>L</u>	<u>ADM-17.32a</u>	<u>N/A</u>	<u>Safety &amp; Health Programs</u>
<u>WBGT Monitoring Form (A-6002-151)</u>	<u>N</u>	<u>Y</u>	<u>L</u>	<u>ADM-17.32a</u>	<u>N/A</u>	<u>Safety &amp; Health Programs</u>
<u>Industrial Hygiene Continuation Form (A-6004-020)</u>	<u>N</u>	<u>Y</u>	<u>L</u>	<u>ADM-17.32a</u>	<u>N/A</u>	<u>Safety &amp; Health Programs</u>
<u>Industrial Hygiene Technician's Monitoring Field Notes</u>	<u>N</u>	<u>Y</u>	<u>L</u>	<u>ADM-17.32a</u>	<u>N/A</u>	<u>Safety &amp; Health Programs</u>
<u>Industrial Hygiene Pulse Rate Monitoring Form</u>	<u>N</u>	<u>Y</u>	<u>L</u>	<u>ADM-17.32a</u>	<u>N/A</u>	<u>Safety &amp; Health Programs</u>

- ~~Industrial Hygiene Direct Reading Instrument Survey form (A-6001-760)~~
- ~~WBGT Monitoring Form (A-6002-151)~~
- ~~Industrial Hygiene Continuation Form (A-6004-020)~~
- ~~Industrial Hygiene Technician's Monitoring Field Notes~~
- ~~Instrument and Equipment Maintenance Record~~
- ~~Industrial Hygiene Pulse Rate Monitoring Form (Attachment E).~~

Any maintenance activities involving equipment identified in this procedure must be approved by the Industrial Hygiene Technician supervisor, and recorded on the Instrument and Equipment Maintenance Record.

The ~~identified records custodian-Industrial Hygiene Program Records Coordinator~~ is responsible for record ~~management-retention and retirement~~ in accordance with [TFC-BSM-IRM DC-C-02](#) and ~~TFC-ESHQ-S\_IH-C-46 TFC-ESHQ-IH-STD-03.~~

## 7.0 SOURCES

### 7.1 Requirements

1. 10 CFR 851, “Worker Safety and Health Program.”

2. DOE O 440.1A, 03-27-98, Attachment 2, Section 12.g. (S/RID)

### 7.2 References

1. 29 CFR 1910.120, “Hazardous Waste Operations and Emergency Response.”

2. 29 CFR 1926.10(a), “Scope of Subpart.”

3. 29 CFR 1926.65, “Hazardous Waste Operations and Emergency Response.”

4. American Conference of Governmental Industrial Hygienists (ACGIH), “Threshold Limit Values for Chemical Substances, Physical Agents and Biological Exposure Indices.”

5. Nonin Operator’s Manual, 9500 Onyx Finger Pulse Oximeter, English, Nonin Medical, Inc. Plymouth, Minnesota, USA, December 1998.

6. TFC-BSM-IRM\_DC-C-02, “Records Management.”

7. TFC-ESHQ-RP\_ADM-CD-21, “Radiological Controls for Heat and Cold Mitigation.”

8. TFC-ESHQ-RP\_MON-C-22, “Drinking in a Contamination Area or Radiological Buffer Area.”

9. TFC-ESHQ-S\_IH-C-17, “Employee Job Task Analysis~~Occupational Medical Qualification and Monitoring.~~”

10. TFC-ESHQ-S\_IH-C-46, “Industrial Hygiene Reporting and Records Management.”  
~~TFC-ESHQ-IH-STD-03, “Exposure Monitoring, Reporting and Records Management.”~~

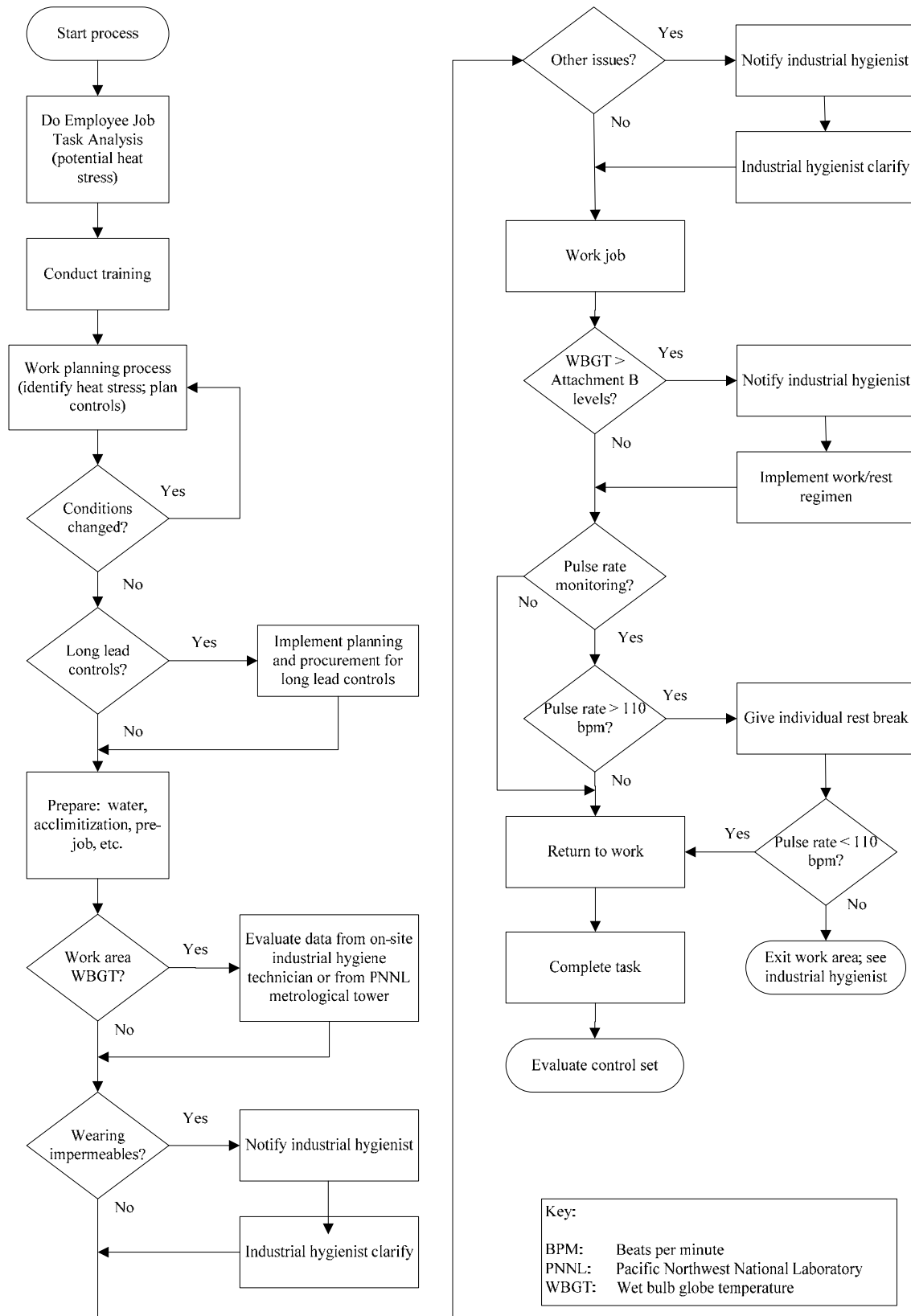
11. TFC-ESHQ-S\_IH-D-26 “Using Heat Stress Monitors.”

12. TFC-ESHQ-S\_SAF-C-01, “Safety Meetings.”

13. TFC-OPS-MAINT-C-01, “Tank Farm Contractor Work Control.”

14. TFC-OPS-MAINT-C-02, “Pre-Job Briefing.”

Figure 1. Heat Stress Control.



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## ATTACHMENT A – HEAT STRESS MITIGATION CHECK LIST

This check list should be used as guidance when a job or worksite hazard analysis identifies the potential for workers to work in a heat stress environment where the WBGT indicates additional controls are required. This can also be triggered by the wearing of impermeable protective suites and applies to both an acclimated and unacclimated work force. Field work supervisors, safety professionals and the work force should evaluate the complete scope of the work, identify when a potential for heat stress is present and determine mitigation of the potential using ALARA concepts. The mitigation should be implemented using engineering controls, administrative controls, PPE, and/or physiological monitoring or combination of the above.

### **Engineered Controls:**

- \_\_\_ Containment Tent with recirculating air conditioning
- \_\_\_ Containment Tent with once through air conditioning
- \_\_\_ Containment Tent with swamp cooling air conditioning
- \_\_\_ Misters, fan mounted
- \_\_\_ Misters, tubing runs without fans
- \_\_\_ Recirculating Air with just a fan, < 95 degrees
- \_\_\_ Others, \_\_\_\_\_.

### **Administrative Controls:**

- \_\_\_ WBGT jobsite monitoring by IH
- \_\_\_ Direct Industrial Hygienist control of the specific work scope
- \_\_\_ Perform work in a cooler time of the day
- \_\_\_ Crew briefing on hydration (water or electrolyte replacement-Sqwincher/Gatorade)
- \_\_\_ Rotate Tasks between workers.

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# **ATTACHMENT A – HEAT STRESS MITIGATION CHECK LIST (cont.)**

## **PPE:**

- \_\_\_ Arctic Heat Cooling Vest
- \_\_\_ Water-cooled cooling vest
- \_\_\_ OREX PVA coveralls, single or double set, depending on radiological conditions
- \_\_\_ OREX PVA coveralls, water proof, when the potential for liquid exposure exists
- \_\_\_ Camel back water hydration when wearing protective clothing including an air fed hood.

## **Physiological Monitoring:**

- \_\_\_ Heart Rate Pulse monitoring for screened work force
- \_\_\_ Other personal monitoring as approved by Management Directive.

## **ATTACHMENT B – GUIDANCE FOR ESTABLISHING WORK/REST REGIMENS**

Table B-1 provides the ACGIH heat stress threshold limit values (work/rest regimens) for different clothing types and work activity levels. The presumption of ACGIH, and this procedure, is that activities under heat stress conditions are to be controlled in work/rest cycles of no greater than one hour increments. The application of work/rest regimens varies depending on the work activity level (work load), WBGT indices, clothing, worker's level of acclimatization, and water availability. See notes below for restrictions/conditions in applying this table.

### **INSTRUCTIONS:**

1. Contact the industrial hygienist to obtain the estimated work activity level (workload) and acclimatization assessment - use the applicable section of the table.
2. Determine the type of clothing ensemble worn - use that section of the table. (See definitions section of this procedure for information on clothing types identified in Table B-1).
3. Measure (or estimate) work site specific WBGT values. (Estimated values can be based on data provided by the PNNL weather station.) Per ACGIH, where WBGT values vary significantly within any work/rest cycle an average (e.g., representative) value should be used.
4. Within the table sections selected in steps 1 and 2 above, find the WBGT value in the table that exceeds the WBGT value from step 3 above.
5. Read to the left to find the work-rest regimen to be applied.
6. Consult Industrial Hygiene for guidance if:
  - Conditions are in the 50/50 and 25/75 percent column of the table
  - Work shifts of more than eight hours.

### **NOTES:**

- Table values assume eight-hour work days in a five day work week with conventional breaks.
- Table values assume rest is in the same environment (WBGT level) as the work activity (see industrial hygienist for further guidance).
- Consult the industrial hygienist for any equivalencies of clothing ensembles worn not listed in the definitions.
- This table assumes employees do not wear protective equipment to reduce heat exposure.
- In accordance with interpretive guidance from the American Conference of Government Industrial Hygienists, no correction factors will be applied to workers wearing air purifying or air-line respirators. The correction factor for a self-contained breathing apparatus (SCBA) will be an increase by one Work Demand (work load) for the proposed work activity.

**ATTACHMENT B – GUIDANCE FOR ESTABLISHING WORK/REST REGIMENS (cont.)**

- This table does not provide limits for wearing clothing that severely restricts heat removal, such as water-vapor-impermeable, air-impermeable, and thermally-insulating clothing; encapsulating suits; or multiple layered clothing not represented above.

**Table B-1 (See instructions and notes on the previous page)**

		ACCLIMATIZED				UNACCLIMATIZED			
	Work Demands	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
ONE CLOTHING LAYER	100% Work	85.1 F	81.5 F	78.8 F	N/A	81.5 F	77.0 F	72.5 F	N/A
	75% Work 25% Rest	86.9 F	83.3 F	81.5 F	N/A	84.2 F	79.7 F	76.1 F	N/A
	50% Work 50% Rest	88.7 F	85.1 F	83.5 F	81.5 F	86.0 F	82.4 F	79.7 F	77.0 F
	25% Work 75% Rest	90.5 F	87.8 F	86.0 F	85.1 F	87.8 F	84.2 F	82.4 F	79.7 F
TWO LAYERS	100% Work	78.8 F	75.2 F	72.5 F	N/A	75.2 F	70.7 F	66.2 F	N/A
	75% Work 25% Rest	80.6 F	77.0 F	75.2 F	N/A	77.9 F	73.4 F	69.8 F	N/A
	50% Work 50% Rest	82.4 F	78.8 F	77.0 F	75.2 F	79.7 F	76.1 F	73.4 F	70.7 F
	25% Work 75% Rest	84.2 F	81.5 F	79.7 F	78.8 F	81.5 F	77.9 F	76.1 F	73.4 F
THREE LAYERS	100% Work	76.1 F	72.5 F	69.8 F	N/A	72.5 F	68.0 F	63.5 F	N/A
	75% Work 25% Rest	77.0 F	74.3 F	72.5 F	N/A	75.2 F	70.7 F	67.1 F	N/A
	50% Work 50% Rest	79.7 F	76.1 F	74.3 F	72.5 F	77.0 F	73.4 F	70.7 F	68.0 F
	25% Work 75% Rest	81.5 F	78.8 F	77.0 F	76.1 F	78.8 F	75.2 F	73.4 F	70.7 F

Clothing layer descriptions. Consult the Industrial Hygienist for further equivalencies.

One clothing layer: Traditional work uniform of a long-sleeved shirt and pants or one pair of Anti-Cs over modesty clothing.

Two layers: Clothing ensemble representing cloth overalls over the work uniform above. Equivalent to two pair of Anti-Cs over modesty clothing.

Three layers: Clothing ensemble representing two pair of cloth overalls (or two pair of Anti-Cs over the summer uniform. Equivalent to three pair of Anti-Cs over modesty clothing.

Modesty clothing: Personal choice clothing ensemble including shoes, socks, briefs, shorts, and T-shirt (scrubs, or equivalent loose/light garments may be substituted for shorts and/or T-shirt) to be worn under layers noted above.



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## **ATTACHMENT C – HEAT STRESS SUPPLEMENTAL CRITERIA**

### **CONTROLS FOR HEAT STRESS**

Use Attachment A to develop the control set for Heat Stress Mitigation

### **DRINKING WATER/FLUIDS**

Maintaining adequate body hydration is an important protective measure against heat strain. General guidelines for fluid intake to maintain body hydration are as follows:

- Ensure water is accessible to employees in the work area..
- Water should be cool (50°F), not cold.
- Drink small volumes (approximately 1 cup) of cool water about every 20 minutes.
- Salt tablets should not be used as part of fluid supplementation.

### **HEAT STRESS BRIEFING CONTENT**

Heat stress briefings will address the following information:

- a. Identification of heat stress hazards and potential health effects.
- b. Predisposing factors and relevant signs and symptoms of heat injury and illness.
- c. Information on water intake replacement.
- d. Heat stress control strategies such as work practices and engineering controls, proper acclimatization, and proper use of heat stress personal protective equipment.
- e. Potential for therapeutic drugs, over-the-counter medications, or social drugs (including alcohol) to increase the risk of heat injury or illness by reducing heat tolerance.
- f. Other factors such as: lifestyle, age, gender, or medical conditions.

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## ATTACHMENT C – HEAT STRESS SUPPLEMENTAL CRITERIA (cont.)

### HEAT STRESS RISK FACTORS

Consider the following risk factors when evaluating a work environment for heat stress potential:

- a. High ambient temperatures.

NOTE: For the Hanford Site there is a risk of outdoor heat stress from May 1 until October 1.

- b. Work performed in greenhouses (containment tents) or other environments with minimal air movement during conditions that could result in heat buildup.
- c. Humidity.
- d. Use of protective clothing (coveralls, Tyvek<sup>1</sup> coveralls, semi-permeable, or impermeable chemical protective clothing) that can impair the body's ability to regulate heat.
- e. Work requiring moderate to heavy physical labor (esp. where heavy clothing is worn).
- f. Sources of radiant heat, such as steam pipes, boilers, heated vessels.
- g. Direct physical contact with hot objects.

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<sup>1</sup> Tyvek is a registered trademark of E. I. du Pont de Nemours and Company.

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## ATTACHMENT D – HEAT STRESS TECHNICAL CRITERIA

### WBGT INSTRUMENTATION FOR HEAT STRESS MONITORING

Thermal stress is a function of air temperature, solar and thermal radiation, relative humidity, air movement, and the physiologic condition of the worker. Where conditions of humidity, sunlight, or radiant heat exist, dry bulb measurements alone are inadequate as indicators of the proper work/rest regimen. Environmental monitoring instrumentation is obtainable through the Industrial Hygiene Group and the Site Industrial Hygiene Equipment Lab. Automated equipment is available that integrates the three temperature measurements and provides a digital readout. If equipment is used that provides individual wet bulb, globe, or dry bulb temperature measurements, use one of the two WBGT indices below:

(a) Equation 1 is applicable to outdoor conditions with solar load:

$$\text{WBGT} = 0.7 (\text{wet bulb temp.}) + 0.2 (\text{globe temp.}) + 0.1 (\text{dry bulb temp.})$$

(b) Equation 2 is applicable to indoor/outdoor conditions without solar load:

$$\text{WBGT} = 0.7 (\text{wet bulb temp.}) + 0.3 (\text{globe temp.})$$

### WBGT MONITORING - GENERAL AREA

The PNNL weather station provides WBGT readings during daylight hours, Monday through Friday, between May 1 and October 1, and until 12:00 p.m. on weekends and holidays. These readings are taken between the 200 East and 200 West Areas, and can be used as representative for most outdoor locations at Hanford. However, depending on specific work site conditions, the readings may not directly apply to any given work site.

As determined by Industrial Hygiene, supplementary WBGT readings may be necessary when work is performed inside containment tents, greenhouses, or other enclosures between the spring and fall months (approximately May 1 to October 1).

### WBGT MONITORING - WORK SITE SPECIFIC

Conditions that may warrant work site WBGT readings include:

- Work performed in greenhouses, containment structures, or other enclosures during hot conditions with potential for heat stress.
- Use of protective clothing not covered by the descriptions in Attachment A.
- As prescribed by Industrial Hygiene.

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## ATTACHMENT D – HEAT STRESS TECHNICAL CRITERIA (cont.)

### HEAT STRESS ACCLIMATIZATION

Acclimatization requires physical activity under heat stress conditions similar to those anticipated for the work being performed. A person is considered acclimatized if they have a recent history of heat-stress exposures of at least 2 continuous hours for 5 of the last 7 days. This is consistent with guidance from the Hanford Site Occupational Medical contractor that for individuals living in the Hanford area who regularly perform outdoor work activities, heat stress acclimatization is a natural process that accompanies the seasonal onset of warmer weather. Exposures to sudden higher levels of heat stress conditions, such as a heat wave, are not considered in determining acclimatization. Loss of acclimatization occurs after 4 days of activity without heat stress conditions. Determination (and communication) of the actual date for acclimatization for each worker will be the responsibility of the Field Work Supervisor with the assistance of the organizational Industrial Hygiene representative.

### ESTIMATING WORK ACTIVITY LEVELS

Work activity levels (work load) are determined by the industrial hygienist and based on the following ACGIH categories.

- Rest includes sitting quietly in place or sitting with moderate arm movements and is in the same environment (WBGT level) as the work activity. Relocation to a shaded environment or area cooled by air conditioning and/or removal of personal protective equipment to allow for more effective cool-down between work periods may be considered where possible,

NOTE: If work and rest environments are different, ACGIH recommends that hourly time-weighted averages should be calculated and used.

- Light work includes sitting with moderate arm and leg movements; standing with light work at a machine or bench while using mostly arms or with some walking about; using a table saw.
- Moderate work includes scrubbing in a standing position; walking about with moderate lifting or pushing; walking on level at 6 km/hr while carrying a 3 kg weight load.
- Heavy work includes hand sawing carpentry; shoveling dry sand; heavy assembly work on a non-continuous basis; intermittent heavy lifting pushing or pulling (e.g., pick-and-shovel work).
- Very heavy work includes strenuous work such as shoveling wet sand.

Per ACGIH guidance, work activity levels should be assessed based on essentially continuous activity levels within one-hour intervals. Time-weighted averages for work rates should be used when the work demands vary within the hour.

ATTACHMENT E – SAMPLE INDUSTRIAL HYGIENE HEART RATE MONITORING FORM

Date: \_\_\_\_\_

Worker Name: \_\_\_\_\_ Worker HID # \_\_\_\_\_

Worker Age: \_\_\_\_\_ Maximum sustained heart rate 180- age = \_\_\_\_\_

Location: \_\_\_\_\_

Task Description: \_\_\_\_\_

Clothing Requirement: Permeable Impermeable (circle one)

Pre-Work/Resting Heart Rate: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

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Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Heart Rate Reading: \_\_\_\_\_ Time: \_\_\_\_\_

Description of PPE worn: \_\_\_\_\_

Monitoring Results:

Maximum sustained heart rate: \_\_\_\_\_

Recovery heart rate: \_\_\_\_\_ (should be less than 110 bpm after one minute of recovery)

Recommendations/Notifications: \_\_\_\_\_

Industrial Hygiene Review:

Prepared by: \_\_\_\_\_ date: \_\_\_\_\_

Reviewed by: \_\_\_\_\_ date: \_\_\_\_\_